

REMARKS

The Office Action raised issues on the specification and applicant has submitted herein a clean Substitute Specification along with a marked up specification in accordance with MPEP §608.01(q).

The Substitute Specification includes no new matter.

Applicant has addressed both the 35 U.S.C. §112 issues and the objections to Claims 48 and 49.

The Office Action raised an issue of new matter in Claim 37 wherein the carbonized plant material and calcium ions were cooled to an ambient temperature. Applicant would point to Paragraph 0020 of our U.S. Patent Publication 2007/0123420, which clearly states that the raw material is in contact with a solution containing calcium ions, is carbonized, and then subsequently “the material is cooled naturally after the temperature for carbonization.” Clearly for the material to cool naturally would be cooling it to “an ambient temperature.”

Applicant, however, has amended Claim 37 to state “the carbonized plant material and calcium ions are cooled before applying an acid solution.” It is respectfully submitted that there is more than adequate support in our specification for this current claim material.

Our invention is directed to providing a relatively inexpensive yet improved carbon material that can be formed from plant material and more particularly, plant material having conductive tissue such as vessels, tracheids and sieve tubes that are capable of soaking up a solution including, for example, calcium ions from a liquid lime water or milk of lime immersion. Thus, calcium ions can be introduced to the plant material prior to any carbonization to form an intermediate product.

Note, "activated carbon" is generally directed to increasing the effective area interface by, for example, creating a very porous surface area for increasing the direct contact area of carbon with the pollutant to be removed. Thus, adding a filler material that can be leached by an acid can create a more porous carbon structure with greater surface area.

The purpose of our weak acid bath after carbonization is to only remove extra crystals of CaCl_2 and leave anions of calcium ions.

There is certainly no teaching in any of the cited art of a successful utilization of plant material with a high adsorbing capability that is carbonized so that it has a high adsorbing capability due to an ion exchange with respect to one of nitrate nitrogen, nitrite nitrogen and a fluoride ion having a small ionic radius. A corresponding current Japanese application and a Korean application to the present U.S. application have been granted patents for these improvements in Japanese Patent Nos. 3718517, 3718,520, 3822888 and 3822894, along with the Korean Patent No. 10-0795118.

As can be determined from our claims, specification and drawings, our invention can introduce calcium ions to raw plant material and after appropriately soaking the plant material, subsequently carbonized the raw plant material without any activation of the carbon for increasing a physical adsorption effective area. Thus, it can be understood by a person of ordinary skill in this field that the resulting intermediate product can have a reduced specific surface area under the respective temperature conditions as defined in our specification, compared with the material to which calcium has not been introduced and is not activated.

Thus, the subject material can be carbonized without being activated in the sense of increasing a physical adsorption effective area. This can be seen from the following.

[Table 1]

Temperature of heat treatment	Specific surface area (m ² /g)	
	No-treatment	Present invention
600 °C	320	140
700 °C	360	170
800 °C	440	260

In the production of activated carbon, activation is performed in order to increase the specific surface area and enhance the physical adsorption capability. In the present invention, however, activation causes the structure “carbide-Ca-C1” which is a key to adsorb anions through ion exchange to disappear, and thus provides opposite effects (see Table 2). The other side of the equation is that, due to this, the activated carbon subjected to activation never has the anion adsorption capability due to ion exchange and thus can never have anion adsorbing capability at a practical level.

[Table 2]

	Activation	Functional group	Ion exchange
Present Invention	Non-activated	Carbon-Ca-C1	Possible
Activated Carbon	Activated	Burnt down	Impossible

That is, activated carbon, generally considered to be versatile, cannot physically adsorb anions, especially, having a small ionic radius (such as a nitrate ion, a nitrite ion or a fluoride ion), and has quite a low adsorption capability thereto, which does not reach a practical level. Thus, activated carbon has not been used for the purpose of adsorbing these anions.

For confirmation, the evidence data on the capability of activated carbon to adsorb nitrate nitrogen, nitrite nitrogen or a fluoride ion is obtained as follows (see Table 3).

Coconut husk activated carbon having excellent adsorption capability actually used for purification of water quality still has only a slight adsorption capability to nitrate nitrogen, nitrite

nitrogen or a fluoride ion, and has not reached a practical level for the purpose of adsorbing these anions.

[Table 3]

Adsorbent/amount of adsorption (mg/g)	Nitrate nitrogen	Nitrite nitrogen	Fluoride ion
Ligneous chip raw material of present invention	10.75	9.80	19.00
Anion exchange resin	10.80	10.00	8.50
Coconut husk activated carbon for purification of water quality A	2.00	1.85	0.60
Coconut husk activated carbon for purification of water quality B	0.40	0.32	0.10
Coconut husk activated carbon for purification of water quality C	0.30	0.25	0.20

For the amounts of nitrate nitrogen, nitrite nitrogen and fluoride ion to be adsorbed, the expensive and high-performance A, among the coconut husk activated carbons for purification of water quality A to C, exhibits amounts of nitrate nitrogen and nitrite nitrogen to be adsorbed of only about 2 mg/g, which is only about 1/5 of the amounts according to the present invention, and also has an amount of a fluoride ion to be adsorbed which is only about 1/30 of the amounts according to the present invention. (See Table 3 above)

The 5-fold difference in terms of the amount of adsorption is extremely significant. For example, the amount of an adsorbent periodically exchanged and used to remove nitrate nitrogen in a certain water source is sufficiently 1ton each time in the present invention, but for activated carbon, at least 5tons is required each time. Further, supposing that the unit prices of the

adsorbent according to the present invention and the activated carbon are set to be the same price, the present invention can purify the nitrate nitrogen contamination in the water source with the cost which is 1/5 as compared with that of the activated carbon.

At present, one reason why activated carbon is not used to deal with nitrate nitrogen contamination and the like is its low capability to adsorb nitrate nitrogen, and thus the present invention which provides an adsorption capability 5 folds as high as that of activated carbon can reach an adsorption capability at the level of conventional expensive anion exchange resins, which has reached a practical level.

Further, there has conventionally been no technique of imparting anion exchange capability to carbon materials comprising a plant raw material to obtain a high adsorption capability with respect to nitrate nitrogen, nitrite nitrogen or a fluoride ion as in the present invention.

For example, when the nitrate nitrogen contamination in a water source is purified, an anion exchange resin is too expensive, and activated carbon has too low adsorption capability and thus cannot be used. Accordingly, no countermeasure could be taken.. However, the adsorption capability at the level of anion exchange resins can now be realized at a low cost at the level of activated carbon in the present invention, and thus this technique becomes applicable. Consequently, the problem of harmful anions can be solved.

The Office Action asserted that Claims 30, 31, 38 and 49 were completely anticipated by *Yamaguchi* (U.S. Patent No. 4,937,223) under 35 U.S.C. §102. The Office Action further cited that utilization of a carbonizing material with a chemical activating agent is well known for “over 75 years.”

However, even improvements in a highly crowded field that provide both a practical and novel approach is considered worthy of patents.

“Thus when differences that may appear technologically minor nonetheless have a practical impact, particularly in a crowded field, the decision-maker must consider the obviousness of the new structure in this light.”

Continental Can Co. USA Inc. v. Monsanto Co., 20 U.S.P.Q. 2d. 1746, 1752 (Fed. Cir. 1991).

The *Yamaguchi* reference indicated that activated carbon was commercially available and was prepared from coconut shells, sawdust or coal as a starting material and formed generally by a steam-activated carbon or a zinc chloride-activated carbon. *Yamaguchi* indicated, however, that achieving a high temperature for the steam-activated carbon was relatively expensive and that preparing carbon from coconut shells creates issues of supply, while coal presented undesirable by-products. The solution taught by *Yamaguchi* was to use a lignin derivative such as wastewater or black liquor from pulp making wherein calcium oxide or barium oxide was added to the wastewater for the purpose of precipitating inorganic salts whereupon a “supernatant (was created) as the starting material.” See Column 2, Lines 26-30. Note, this teaches leaving only carbon material and any additive is to activate the carbon (increase pore size).

More specifically, a person of ordinary skill in the field would be taught to use sodium hydroxide or potassium hydroxide from 0.1 to 10 parts by weight relative to 1 part by weight to a liquid, containing lignin from the pulp making procedure. The material is then put into a carbonization furnace with no further explanation (a person with ordinary skill in the art would understand what is a carbonization furnace) and the water would be distilled off when the

temperature was raised from 400 to 650 °C to provide both a carbonization and activation simultaneously.

Subsequently, water is added to participate the inorganic salts, thereby recapturing the sodium hydroxide or potassium hydroxide in accordance with a definition of supernatant. During the washing procedure, the pH of the carbon material becomes approximately 7. See Column 3, Lines 4-10.

Basically, as set forth in the *Yamaguchi* claims, only an activated carbon product is produced without any teaching or ability as defined in our current claims, to provide an anion adsorbing carbon material of the type defined by our method steps set forth herein.

Thus, the Office Action in concentrating on just the activated carbon, misconstrued the teaching of our carbonization of the raw plant material for the purposes of leaving calcium ions in the final carbon material. The carbon mixture carries the calcium ions that can be exchanged to provide a high adsorbing capability by an ion exchange with respective a nitrate nitrogen, a nitrite nitrogen and a fluoride ion having a small ionic radius. This is accomplished in both a unique and relatively cost efficient procedure in the present invention.

Our Claims 33-37, 40-41 and 43-48 were held to be obvious over the *Yamaguchi* reference based upon a broad assertion as to what would be obvious to a person of ordinary skill in the field and a contention that defining optimum or workable ranges by routine experimentation would simply be obvious to a person skilled in this field.

Applicant respectfully disagrees with this assertion.

The *Yamaguchi* reference is not attempting to solve nor provide anything other than a pure activated carbon product, and is certainly not teaching an anion adsorbing carbon material of our present invention. *Yamaguchi* teaches a neutralization and removal of the alkali, including

any alkaline earth metals, and reuse by both washing with water and with a diluted acid until a neutral pH is secured.

As shown by the sole drawing, the *Yamaguchi* reference, to a person of skill in this field would be taught to provide an activated carbon to achieve a specific pore size redistribution as the primary goal of this teaching.

While “the discovery of an optimum value of a variable in a known process is normally obvious,” *In re Antonie*, 559 F.2d 618, 620 (CCPA 1977), this is not always the case. One exception to the rule is where the parameter optimized was not recognized in the prior art as one that would affect the results. *Id.*

Here, the Examiner has not pointed to any teaching in the cited references, or provided any explanation based on scientific reasoning, that would support the conclusion that those skilled in the art would have considered it obvious to “optimize” the prior art compositions by increasing their viscosity to the level recited in the claims.

Ex parte Whalen et al., Appeal 2007-4423, slip op. at 14 (B.P.A.I. July 23, 2008)

The Office Action further cited *Knobloch et al.* (U.S. Patent No. 3,168,485) for combining with the *Yamaguchi* reference under 35 U.S.C. §103.

The *Knobloch et al.* reference sought to remove metals and particularly, iron from activated carbon as an undesirable component that would create a color problem, particular in aqueous solutions of phthalic acids. *Knobloch et al.* acknowledged that neutralizing activated carbons for decolorization that had a removal of metal content, was extremely expensive. See Column 1, Lines 34-41.

The alleged invention was the discovery of “a process for markedly reducing the metals contents,” especially the iron content of activated carbons with a “solution of benzene polycarboxylic acid in a polar solvent.” See Column 2, Lines 15-19.

As noted, *Knobloch et al.* taught away from the use of strong acids such as hydrochloric and nitric acids, as shown in its Table 1, and its invention is a discovery of a benzene polycarboxylic acid in a polar solvent to remove metals that were inherently found in activated carbon.

To a person of ordinary skill in this field, there is no teaching that could be applied to the *Yamaguchi* reference that would suggest creating an anion adsorbing carbon material in the steps defined in our presently pending claims. Both of the cited references want to only leave a pure activated carbon.

The *KSR* Court noted that obviousness cannot be proven merely by showing that the elements of a claimed device were known in the prior art; it must be shown that those of ordinary skill in the art would have had some “apparent reason to combine the known elements in the fashion claimed.”

In the same way, when the prior art teaches away from the claimed solution as presented here, obviousness cannot be proven merely by showing that a known composition could have been modified by routine experimentation or solely on the expectation of success; it must be shown that those of ordinary skill in the art would have had some apparent reason to modify the known composition in a way that would result in the claimed composition.

Ex parte Whalen et al., Appeal 2007-4423, slip op. at 16 (B.P.A.I. July 23, 2008) (citing *KSR Int’l Co. v. Teleflex Inc.*, 127 S.Ct. 1727, 1741 (2007)).

The present invention has been put into practice and an experimental report published by the Lake Biyo-Yodo River Water Quality Purification Collaboration Experimental Center in Japan had an article published on water quality purification experiments using a nitrate/nitrogen adsorbent according to the present invention and it was found that the functional charcoal material, which is the nitrate/nitrogen adsorbent of the present invention, could adsorb and remove nitrogen that could not be removed with general carbon or activated carbon, presumably

because of the small ionic radius of the nitrate/nitrogen. For the Examiner's information, Lake Biyo is the largest lake in Japan. The article is attached hereto with the enclosed rectangular circled block providing an English translation.

Finally, the Office Action raised an issue with regards to the *Riei Yokiyama et al.* article entitled *Adsorption of Fluorine and Nitrate Ions by Charcoal* as not having a publication date. Enclosed herewith is a full copy along with the cover sheet, showing that the Japanese Society on Water and Environment was issued on March 17, 2004.

Additionally, enclosed are English summaries of the Japanese publications 52-34260, 52-16363, and 48-93591.

It is respectfully submitted that applicant has addressed each of the issues and has provided amended claims that more than adequately are supported by our specification, and would be understood by a person of ordinary skill in this field in order to realize the advantages of our present invention. Our invention, as defined in these claims, are neither anticipated nor taught by any combination of the cited reference.

It is believed the case is now in condition for allowance and an early notification of the same is requested.

If the Examiner has any questions with regards to the prosecution of this matter, the undersigned attorney can be contacted at the listed telephone number.

Very truly yours,

SNELL & WILMER L.L.P.



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